

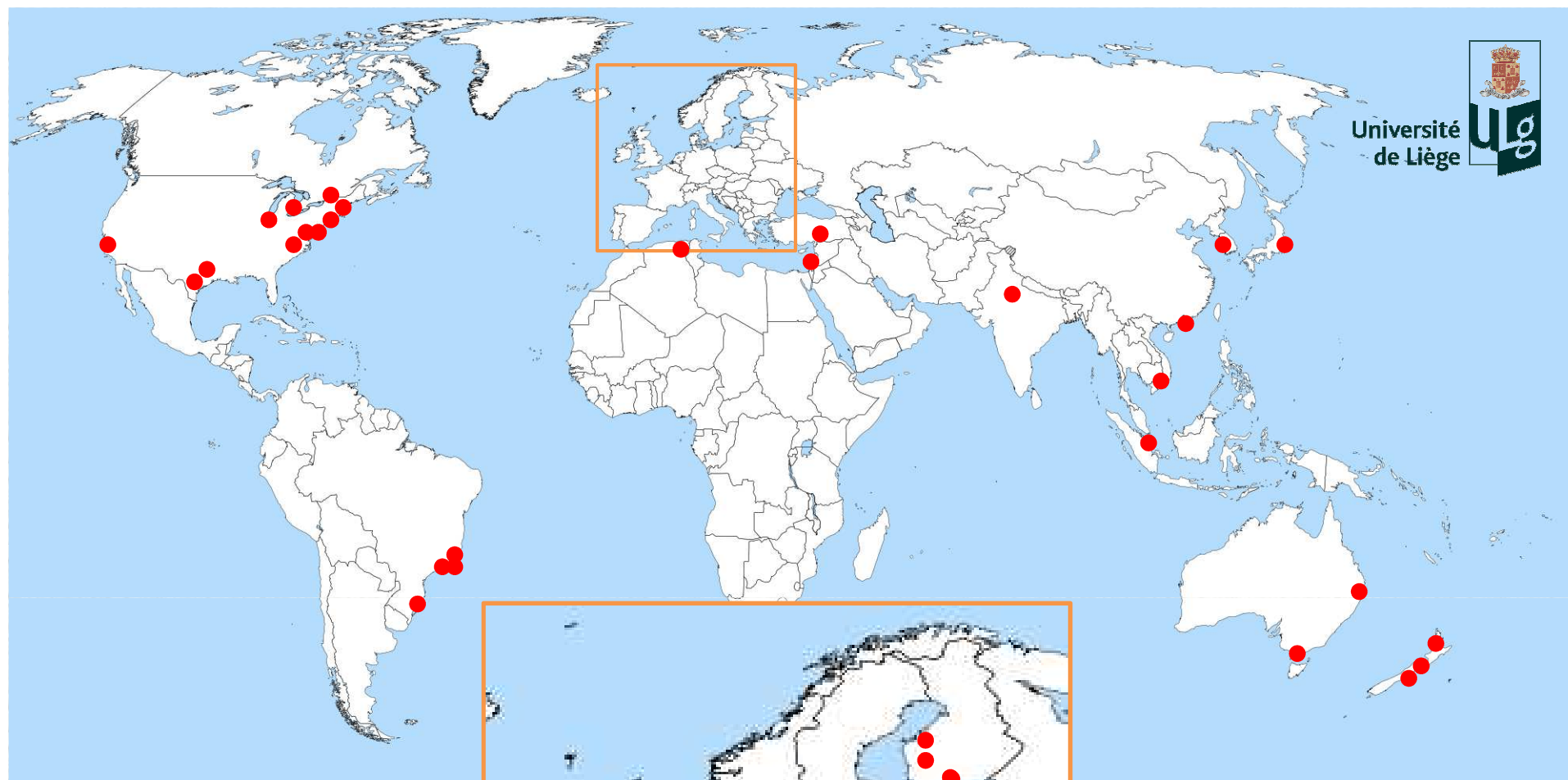
SECURE WITH STEEL

New features in SAFIR

Structural Fire Analysis of a Shell Roof Structure

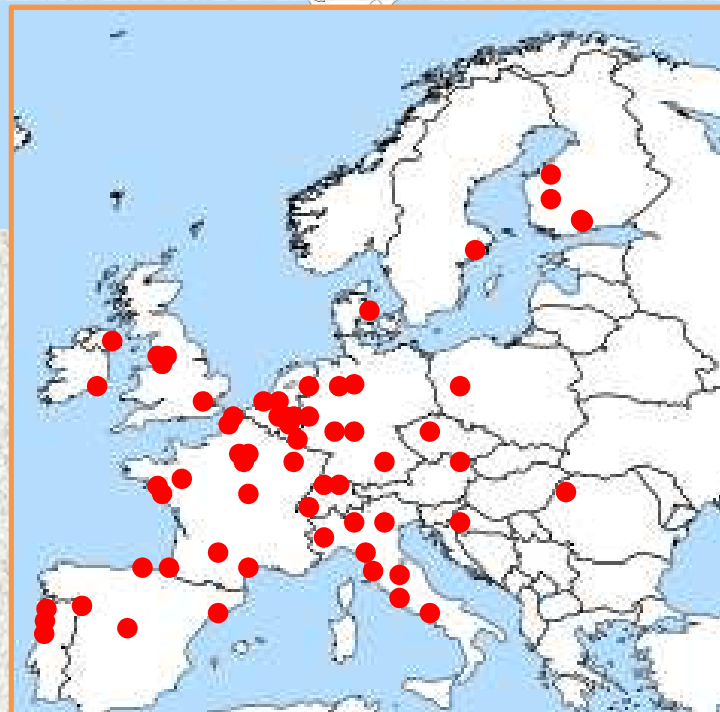
Thomas Gernay
Jean-Marc Franssen

November 2011



SAFIR

in the world



**Non linear finite element
software for structures
in fire**

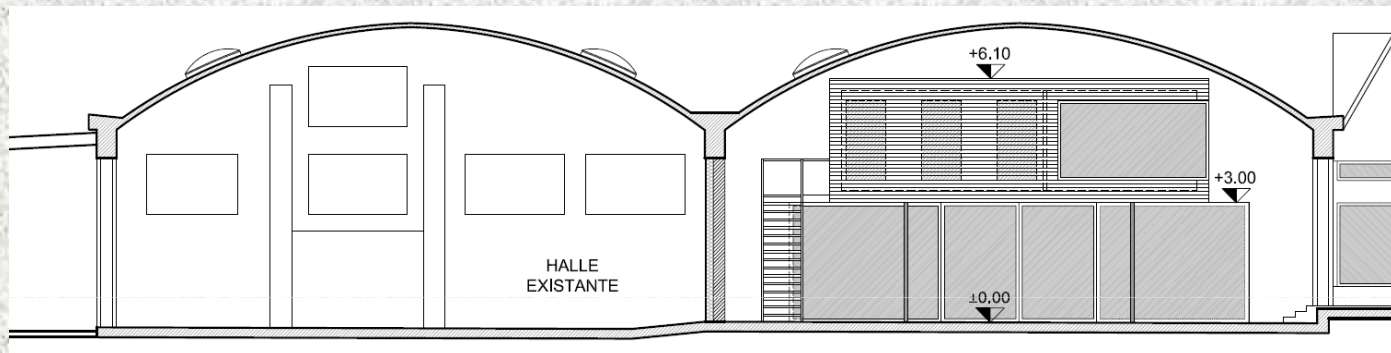
125 users
32 countries
5 continents

New features in SAFIR

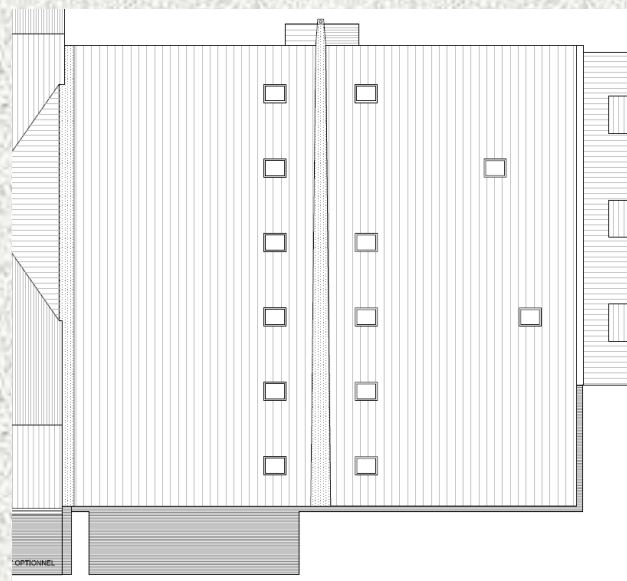
- 1) Concrete - Transient Creep Strain in Eurocode model
- 2) Damage-Plastic Multiaxial Model for Concrete
- 3) Plane Stress Application on a Shell Roof Structure**

Fire analysis of a shell roof structure

- Study performed for ICB - Ingénieurs Conseils en Bâtiments

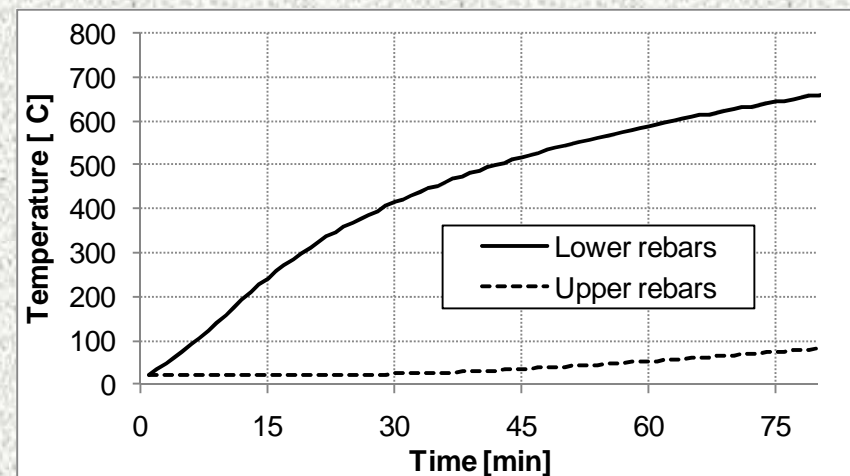
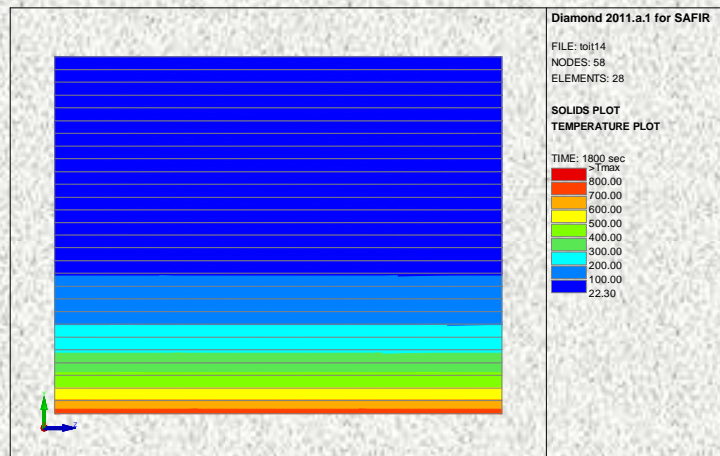


- Structure made of two RC shells equilibrated by steel tie beams every 4.50 m



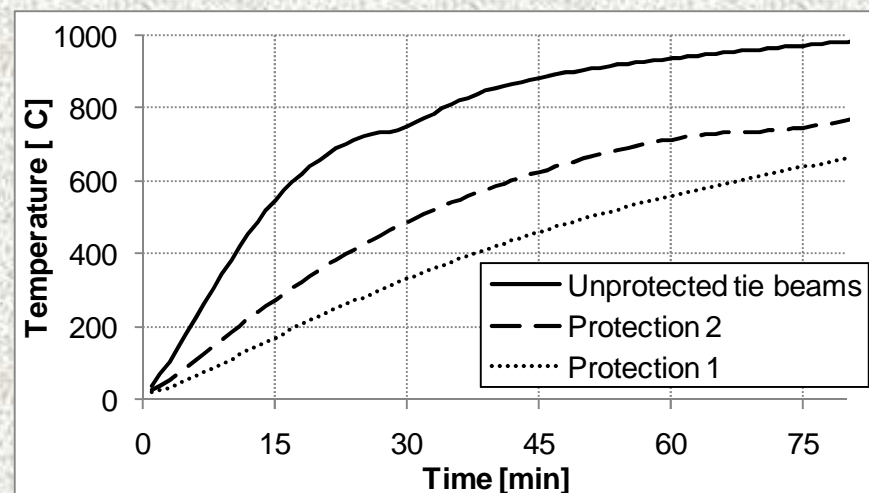
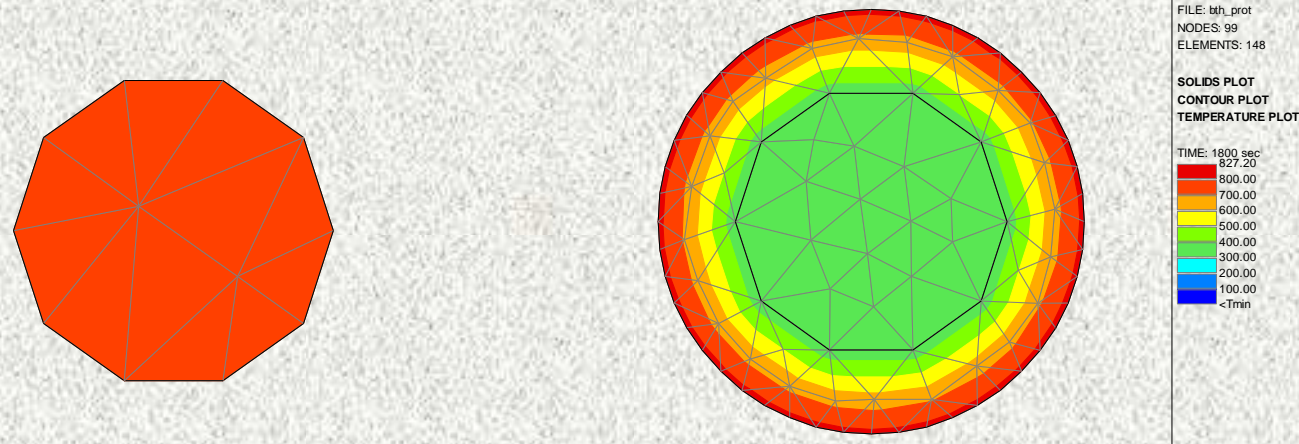
Thermal analysis

- Thermal analysis of the reinforced concrete shell
- Thickness varies between 160 and 100 mm
- Upper rebars remain cold



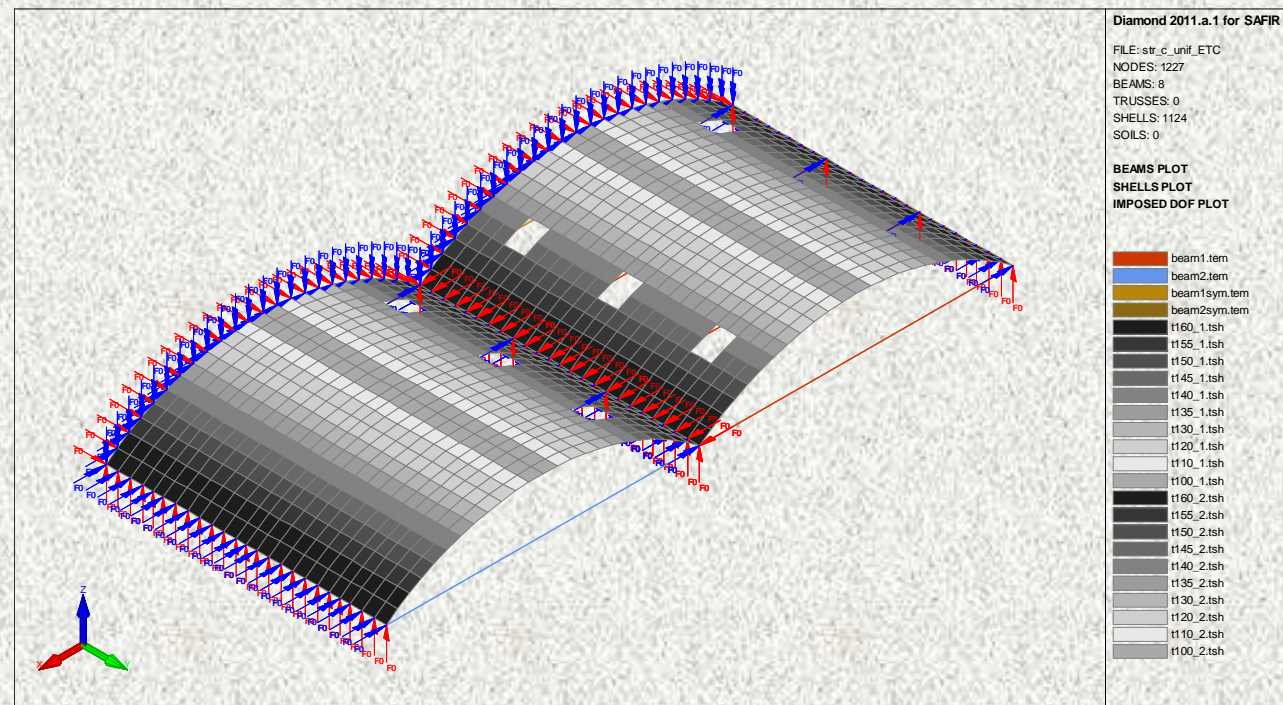
Thermal analysis

- Thermal analysis of the steel tie beams → depends on the thermal insulation



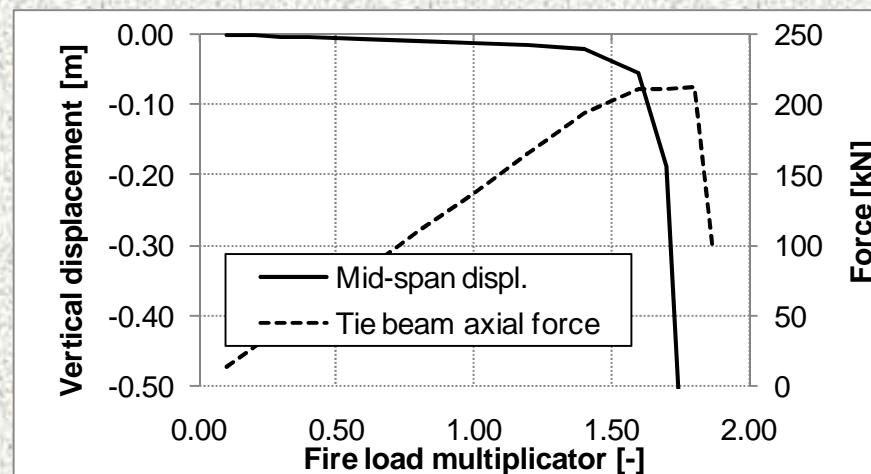
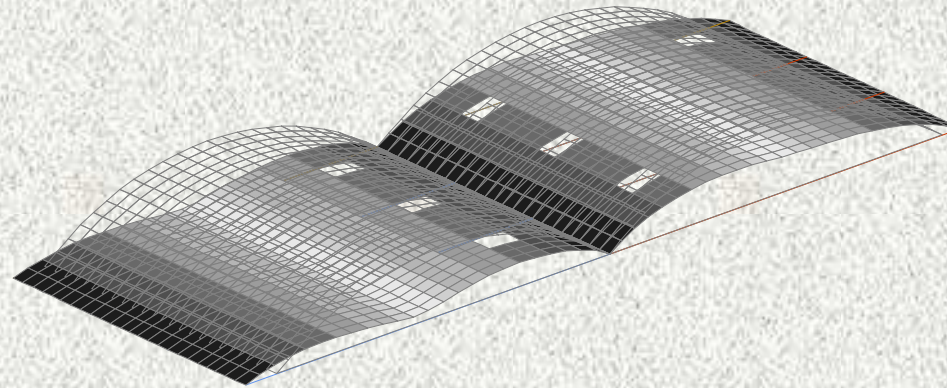
Structural analysis

- Half of the structure is modelled
- ISO fire in one or in the two compartments
- Load = self-weight



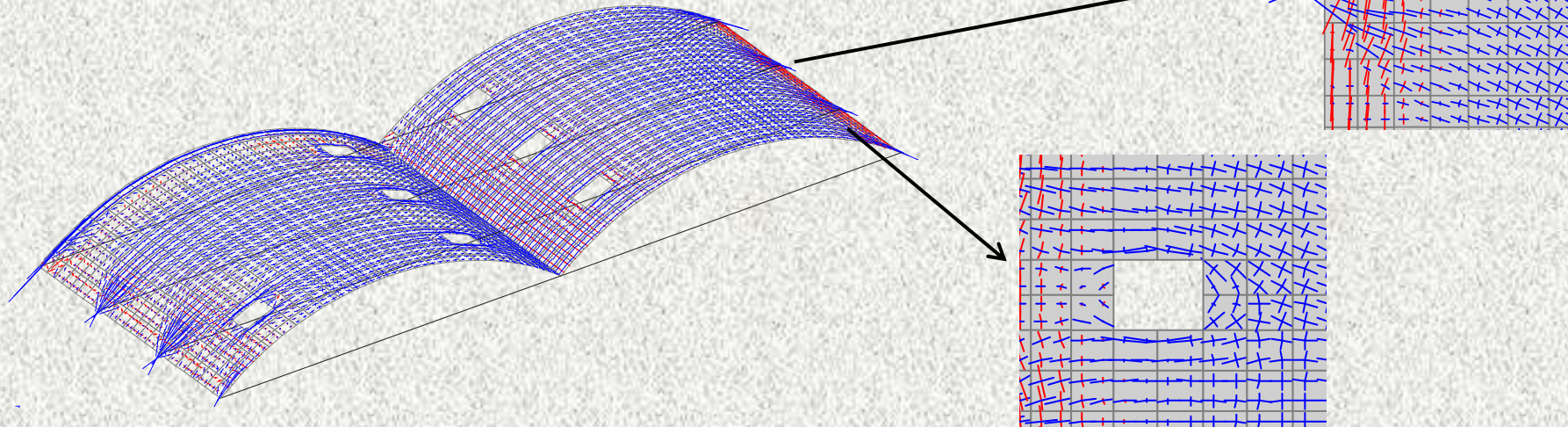
Structural analysis

- First, loading at room temperature until failure



Structural analysis

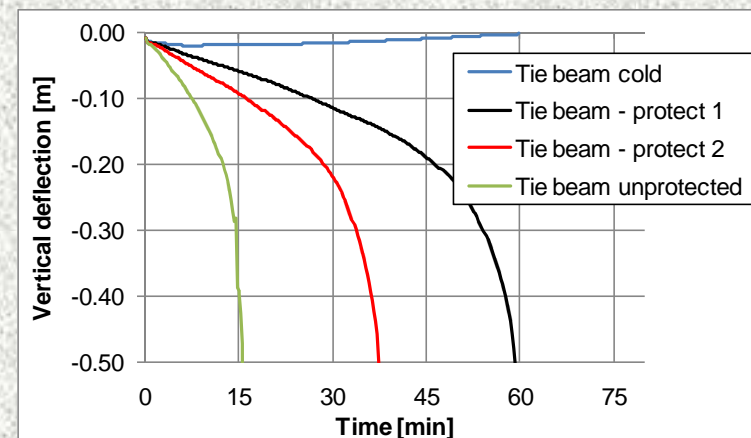
- Membrane forces in the structure



- In fire situation, 2 failure modes could be suspected:
 - Obviously, if the tie beams are left unprotected, thermal elongation of these elements would cause the collapse of the arches (the horizontal force is no more equilibrated)
 - On the contrary, if the tie beams were perfectly protected, restrained thermal bowing of the arches could lead to failure by excess of compression in the concrete

Structural analysis

- Results are given as a function of the thermal insulation of the tie beams
- Fire resistance corresponds approximately to the time when the temperature in the tie beams reaches 550°C



- Only 1st mode of failure is observed (at least for the first 60 minutes)

